Institute for International Integration Studies

IIIS Discussion Paper

No.263 / October 2008

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September 30th, 2008

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Abstract

Overconfidence on the part of bankers and regulators in mechanical risk management models is an important and distinctive driver of bank failures in the current crisis. This paper illustrates the process by drawing on brief case studies of a handful of the biggest failures and losses. There are significant implications for a more holistic and less mechanical approach to risk management and prudential regulation.

Presented at
Federal Reserve Bank of Chicago & European Central Bank Conference
"The Credit Market Turmoil of 2007-8"

Chicago, September 25-26, 2008

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BANK FAILURES: THE LIMITATIONS OF RISK MODELLING

1. Introduction and Summary

This paper argues that overconfidence on the part of bankers and regulators in mechanical risk management models is an important and distinctive driver of bank failures in the current crisis. Following an introduction which explains why this matters and how it is central to the crisis, Section 2 presents case studies of individual bank failures and losses in which this overconfidence and its consequences are illustrated. Each of the chosen cases illustrates one of the four distinctive failure categories in the early phase of the crisis: the diversified survivors; those too opaque to survive market doubts; those that gambled and lost; and over-leveraged mortgage lenders. Apart from the first category, which is represented by a large bank that lost an amount roughly equivalent to its pre-crisis capital, but survived by raising new capital, the remainder of the examples are banks that had to be intervened with fiscal support. Section 3 briefly notes the main dimensions of risk that prove harder to model accurately than is generally believed. Section 4 reviews containment and resolution policy as applied in these cases, and discusses the fiscal costs already identified and provided for: so far these are surprisingly small, but they will rise. Section 5 concludes with some old but highly relevant quotations that point to the significant implications for a more holistic and less mechanical approach to risk management and prudential regulation.

* * *

As much as macroeconomic developments exogenous to the banking system condition the nature, timing and, to a degree, the extent of the ongoing banking crisis, and although the banking difficulties, and the responses thereto, engender costs and consequences for the wider macroeconomic system, it is events and decisions at banks and other financial intermediaries that are at its heart. Understanding what has gone wrong in the institutions that have failed or have suffered severe losses can help the containment effort (which is still in progress at the time of writing), as well as making sure that the resolution effort and the inevitable reforms of regulation and supervisory practice actually serve to reduce the likelihood or severity of future systemic crises.

One approach to commentary on the current financial intermediary crisis is to stress similarities and parallels to crises of the past. Such an approach highlights lessons of the past that have not been learnt and which have returned to impose heavy losses on market participants and government budgets. And goodness knows there are enough such features evident in current events (Brunnermeier, 2008).[1] Examples would be: the problematic incentive structures within financial firms with their bias towards excessive risk-taking; the tendency of lenders to neglect the correlation in price movements of different real estate collaterals, whether residential, commercial or industrial; the opacity of financial intermediaries and the consequent potential evanescence of their access to credit. Disaster myopia (Guttentag and Herring) is alive and well. In fact, Kashyap,

[1] Some oft-heard nostrums are as *un*true this time as they have in the past: for example the supposed need to avoid maturity mismatch or the use of derivatives.

Rajan and Stein (2008), echoing other authors, remark that "a breakdown of incentives and risk control systems within banks" explains why banks held such problematic assets.

It would be discouraging to simply conclude that the lessons of the past had not been learnt, That all that is needed is to re-read Minsky and Fisher and Bagehot and for regulators and bankers to do a better job of applying their profession's conventional wisdom. We need to dig further to try to understand why these failures occurred. In fact, like viruses, banking crises display small but crucial mutations on each return. It is these mutations which mean that even experienced and well-trained risk managers who believe they have insulated their systems against the causes of crisis can be caught out by its emergence in a slightly different guise.

Crisis Cassandras bemoan the fact that the optimists in a booming economy are wrong when they dismiss parallels with past excesses with the over-confident assertion that "this time it will be different" (Shiller, 2006, Reinhart and Rogoff, 2008). Unfortunately, they are right, but not in a good way: this time it is that the risks will be subtly different, so that risk management geared to combat the last crisis may be ineffective, resulting in losses and failures that are all too reminiscent of the past.

Thus in looking at a handful of the largest intermediary losses and failures, there is much to be said for emphasizing what's different this time around. I suggest that there are three especially distinctive features of this crisis so far, and they are well illustrated by the cases in hand. First is the degree to which business models based on huge volume

with wafer-thin margins have been implicated in major losses. Second, and closely related, there has been an altogether new over-reliance on mechanical models of risk (whether credit or liquidity risks).[2] The third distinctive feature must be regarded as provisional, since the full tally is not yet in, and a wide range of uncertainty remains about it, but so far the overall direct fiscal costs of the crisis have been surprisingly low.

To be sure there are other aspects which characterize this crisis, but I suggest that these are at least arguably aspects of what I have suggested as being particularly distinctive this time, or else they are not all that new after all.

For example, the originate-to-distribute model for mortgages is certainly a key and damaging aspect of what we have recently seen – and has been damaging to the borrower in a way that may appear new. But in a larger sense the problems with the originate-to-distribute model are essentially the same as that of the skewed incentive packages offered to many traders now and to loan officers in the not-so-distant past. Much as the mortgage originators don't hold the mortgages on their books, so the loan officer often wasn't around to see their poorly-underwritten loan books coming unstuck. And how different is the distress of the evicted borrower who has been oversold a mortgage from that of the developing country sovereign on whom petrodollar loans were pressed in the 1970s?

[2] Calomiris suggests that risk models were being used to provide "plausible deniability" for conflicted agents and intermediaries rather than being truly believed as risk management tools. (http://www.voxeu.org/index.php?q=node/1561).

Some observers have dubbed this the "structured finance crisis" (cf. Mason, 2008), and that is not a bad choice of distinguishing characteristic. Indeed the financial engineering revolution which enabled the use of complex instruments to pool and hedge risks has been a key driving force setting the scene for the subsequent failures. It drove growth in financial intermediation as it offered low-cost automation of rik management functions thereby allowing new markets, especially retail markets to be reached. But surely those who foresee only a moderation and improvement—not an abandonment—of structured finance are correct.

Instead, it has been the over-reliance on what has proved to be unrealistically simple mechanical risk management models that has turned structured finance into the lethal weapon it has become. It was only because (at some level) risk-takers believed that the models were good enough that the structures became so complex and opaque. In fact as we all know, the models embody many crude approximations at many levels.

Banking is a volume business, and the 20th Century saw a historic rise in leverage however measured. But the explosion of gross positions and gross transactions that has been seen in the past two decades takes the risk pyramid into new territory. There is nothing inherently wrong with this, but it does place risk-models under severe strain. Slight errors in the models are amplified by the volume of transactions. The cliff-edge type consequences of model error in some structured transactions only makes this worse (cf. Joint Forum, 2008). Likewise basis risk can assume an enormous institution-engulfing scale. This is what we see in the case studies. In principle, those risks could

be rewarded sufficiently well to justify the capital cushion that would be needed to truly give adequate assurance of solvency. But in practice the contracted margins have too often been slender indeed, capital assigned zero or negligible and the risks scarcely noticed let alone adequately assessed.

The reliance on models – at least by smaller participants – was indirect: in effect by relying on rating agencies, they were trusting the models used by the raters. They were also trusting the raters. Calomiris (2008) has stressed the agency problems involved here, as did many ex ante (cf. Honohan, 2001). I am proposing, though, that agency was not the only problem, but instead the fact that market participants were dazzled by the new technology and believed it would work far better than was ever going to be possible.

This is not the place to rehearse all of the failures associated with the ratings process, but it is clear that one of the fundamental problems was the widespread belief that the risk profile of any financial structure could be adequately modelled with a variant of standard techniques. Alas, the imperfections of these models were systematically exploited in the design of the structures in a process that, given that the raters did not take explicit account of the fact that the models were not perfect, necessarily flattered at least some structures. To take one important example, consider the by-now well-known fact that underestimating the default correlation between components of the underlying bundle of securities backing an ABS structure can lead to a dramatic increase in the default rate of senior tranches, while actually lowering default rates of the most junior tranches. When the senior tranches are being held by risk-averse investors seeking a few basis points of

additional yield, such small errors can be disastrous for intermediary solvency (while potentially favouring those who hold the "toxic waste"—if average default rates are correctly predicted).

Unwarranted confidence in risk models also had a systemic effect on market participants' expectations regarding the likely availability of funding liquidity. If everyone's risk models were so good, one could ignore the negligible chance of a contagious loss of market confidence leading to a drying-up of funding liquidity to a solvent bank. Hence the over-leveraging occurred in liquidity as well as on the other side of the balance sheet.

While the asset write-downs and estimated future credit losses of the events of the past eighteen months are appreciable, it is noteworthy that most of the largest individual bank losses reported up to September 2008 had been absorbed by existing capital and that almost all of the banks concerned have been able to replenish their depleted capital—albeit not without some hiccups and with considerable dilution of existing shareholders. Partly this reflects growing worldwide concentration of international banking: a loss 40 or 50 times that which brought down Barings bank certainly hurts even one of the world's top dozen banks by assets or capital, but is far from fatal. Partly, though, it reflects the fact that, so far, actual and even projected loan losses represent a much smaller percentage of the GDP of the major countries across whose banks the losses have been distributed, than has been experienced in many previous crises.

A corollary is that, although Central Banks made substantial liquidity loans, often backed with securities of lower credit quality than had been customary, government and its agencies had, until September 2008, absorbed or committed relatively little of the direct costs of bank failure. The asset purchase scheme awaiting approval by the US Congress at the time of writing (end September 2008) heralded a new phase inasmuch as it put the government in the front line for absorbing losses.

Furthermore, the indirect costs of the crisis are likely to be appreciable. It is true that a very substantial portion of the capital lost in the banking system has been replenished—albeit at an appreciable discount to bank equity prices that prevailed in the first part of 2007. But, in shocked reaction to the realization that confidence in risk management models, and in reliable access to liquidity was misplaced, bank managements have tightened credit standards and contracted credit on a broad front. This is already contributing to a broad economic downturn that will increase unemployment, reduce personal income, shrink profits (and lead to failures) of non-financial firms. But that is not my story today.[3]

Experience of previous crises shows that the bad news does not all come at first, and instead emerges over a period of several quarters. At the time of writing it would require heroic optimism to assert that there will be no further surprises. Indeed stock prices and interbank interest rates imply further unannounced losses embedded in bank balance

[3] But is the downturn caused by the banking system or are both endogenous consequences of other factors such as geopolitical instability, changes in relative prices associated with shifting global production patterns, and inappropriate monetary policy? Probably banking system deficiencies have had a relatively larger causal or amplifying effect in this crisis than in others, but this topic is beyond the scope of the present paper.

sheets and activities, but their location not known. In particular, a prolonged growth recession will deepen loan losses unrelated to the US subprime and Alt-A mortgage markets and their counterparts in other countries. Non-mortgage related loan losses are already turning up.

There are policy implications. For all that rules may trump discretion in monetary policy, the opposite seems true for banking risk and bank regulation. The rules of Basel 2 are no better than those being applied by market participants.[4] Quite apart from the pro-cyclical and herding effects which rules-based regulation may induce (as has been argued for example by Dewatripont and Tirole, 1994, Goodhart and Persaud, 2008, Shin et al, 2005, and others—albeit challenged for example by Jorion, 1999), the problem that the rules do not represent a sufficiently precise tool for risk management must be acknowledged. The Basel Committee's working groups are currently revising and adapting the rules to acknowledge some of the most glaring omissions, but this is an effort that has no end. The limitations of the rules need to be recognized and a greater discretionary and judgmental element restored to risk management.[5] That will often mean requiring more capital than the rules calculate and that in turn raises numerous complexities about level playing fields, the political pressure on and even corruption of regulators (a point stressed by Caprio et al., 2005) and makes different and in some respects greater intellectual demands on risk managers, both regulators and regulated.

[4] Accounting rules too are full of oddities that can mislead, such as the valuation of a company's own debt at discounted market value in computing profits (FT "Fair value debt profits surprise analysts." August 8, 2008), and the backward-looking nature of loan-loss reserving in IFRS.

[5] Note that models that are good enough for private sector decisions may not be good enough for public regulation. The risk–return trade-off that each is conducting is complementary to, not the same as, the other. For example, beyond the total probability of insolvency, the probability density for payoffs in the insolvency zone may be of no interest to the owner of a financial intermediary.

The higher capital and heightened sensitivity to risk that has come with the Basel process over the past quarter century have helped reduce the cost to the government's accounts from the crisis. Ensuring that this continues will require greater use of Pillar 2: supervisory discretion to add supplementary capital charges to those generated by formula.

2. Four examples

To provide more concrete substance to these observations, we now turn to a selection of the most important losses and failures. I have not chosen simply the largest losses, (as logged, for example by Bloomberg, Annex Table 2). Instead I have chosen ten intermediaries distinguished both by their scale, by the degree to which they have been documented and by their novelty or salience for illustrating some of the major features of the crisis.

We begin with the important category of banks that did make and report huge losses but survived to date without government assistance. They did not fail and this they managed to do because they were sufficiently large and diversified to have been able to raise additional capital to replace that eroded by credit losses. Our example here is UBS; numerous other cases exist from Citibank (which experienced the largest individual reported loss) down.

Every crisis sweeps away some incompetent, reckless or corrupt bankers and their banks. This is our second category of: referred to for convenience as those that simply gambled and lost. The example we take here is Sachsen LB, and we mention some other which fall into the same kind of area: IndyMac, IKB Deutsche Industriebank, Carlyle Capital and Roskilde Bank.

Then there is the important category of firms that proved too opaque to survive in the market and ran out of liquidity. Our example of this type is the simplest one: Northern

Rock—indeed one of its misfortunes was to face liquidity problems early on when the market was more easily alarmed. Much more complex and opaque cases were the investment banks Bear Stearns (rescued) and Lehmans (not rescued). Perhaps Fortis, Dexia and Hypo, which received sizable government rescue injections in late September, 2008 are also in this category. Mention is also made of AIG – not a bank, but caught up in the crisis through insuring banks (notably with credit default swaps) and falling likely into the "too opaque category".

The final category, and one which seems likely to grow, is mortgage lenders whose main problem was to be too leveraged in a weak property market. We discuss the two largest US Government-sponsored financial agencies Fannie Mae and Freddie Mac. Other cases mentioned under this heading are Washington Mutual, which became the biggest regulated bank to fail in US history in September, 2008 and Bradford and Bingley, intervened by the UK government at the end of that month.

Case A: "Diversified Survivor" UBS (Union Bank of Switzerland)

Unlike the other main cases examined, UBS has not failed and displays no likelihood of failing; no government support whatsoever has been provided or has been in prospect. This is despite reporting losses in excess of US$ 40 billion – much larger than any of the others. The reason is not only that UBS is a much larger entity, indeed it is one of the world's largest banks (being ranked 2nd in the world at end-2006 by total assets and 20th in the world by equity capital in *Euromoney*'s mid-2007 listing and one of about 15 groups classified by the Bank of England as Large and Complex Financial

Intermediaries, LCFIs), but also because it has been subject both to the standard international regime of capital adequacy (Basel I and now Basel II) and to the market discipline that demands even more capital from banks that wish to source uninsured funding in the market. Nevertheless, it has been a fairly close-run thing. Thus, at mid-2007, before the crisis broke, UBS had CHF 51 billion equal to US$ 42 billion of capital. By end-March 2008, this had eroded to CHF 16 billion (=US$ 16 billion) before capital raising efforts to offset losses incurred brought the total back up to CHF 44 billion (=US$ 44 billion) by mid-2008.[6]

UBS' experience: large losses related to acquisition of mainly US-based MBS, is clearly similar in several respects to the large losses made by other LCFIs. It has been better documented so far and therefore serves as a useful exemplar of a half a dozen other cases of large losses by large banks.

Even though the losses could be and were absorbed by the shareholders, they represented a severe blow for a bank which prided itself on – and was widely admired for – its risk management.[7] And they occurred and were reported early in the crisis and cannot be blamed on a generalized downturn. In fact, as is revealed by a report to the shareholders following an independent consultant's *post mortem* (UBS, 2008) the failure must clearly be laid at the door of the risk management system itself. It was not sufficiently elaborate

[6] The ability of banks to replenish lost capital is a crucial element – necessary but not sufficient – in limiting the credit crunch consequences of losses. This aspect was perhaps understressed in the important analyses of Greenlaw et al.. (2008) and Adrian and Shin (2008), though the increasing cost and difficulty that banks such as Royal Bank of Scotland and Bradford and Bingley – both of whose rights issues were largely left in the hands of the underwriters – and the GSEs have had in replenishing capital as bank equity prices continued to drift down during the crisis may have made this neglect realistic.

[7] For example, winning *Euromoney* magazine's "Global Best Risk Management House" award for excellence in 2005.

to capture the full dimensionality of the risks being undertaken by this complex institution: short cuts were taken in the interest of having prompt information available, but these short cuts could be and were systematically gamed by ambitious operations staff who took very large risks but seem to have structured them in such a way that they did not show up at all in the calculation of risk and therefore triggered neither the capital charge nor the kinds of trading limits that would have been warranted.

Most of UBS' losses relate to their portfolio of MBS, many of which were being warehoused for sale to other entities. Evidently, the mark-to-market value of these assets fell sharply during 2007. In broad terms, what appears to have happened – in respect of at least some of the losses – is that insurance and derivatives were bought to hedge only the amount of variation (known to the traders) to which the portfolio was being stress-tested.[8] Market fluctuations larger than envisaged in the stress test were not hedged (otherwise the profit potential of the positions being taken would have been eliminated). In other words, the profits being booked (in the relevant parts of the business) arose primarily because of – and were the reward for – the assumption of catastrophic risk outside that envisaged in the stress test. Senior management understood that certain units were taking large positions, but they assumed that the risk models were good enough to protect against serious loss. Perhaps they would have been good enough if not gamed, but they were not perfect, and that they were gamed was perhaps inevitable.

[8] The bank states that "this level of hedging was based on statistical analyses of historical price movements that indicated that such protection was sufficient to protect UBS from any losses on the position" (UBS, 2008, p. 14). The level of hedging also seems to have been designed to meet internal risk-management rules (Hughes et al., 2008).

Indeed, already in 2006-7 the bank's senior management had coped with an explicit attempt by a significant segment of its capital markets staff to escape from the constraints of the bank's austere risk management structures. Hughes et al. (2008) recounts the establishment of a hedge-fund subsidiary whose activities would not be scrutinized by the bank's risk management systems in a detailed way, but only as an equity investment. The mis-priced risks soon undertaken by the newly-liberated subsidiary quickly proved to be large. The bank realized its error, reported significant losses and folded the capital markets unit back into the normal risk management system.

Huge gross volumes of business built on wafer-thin capital (because of the miscalculation of the potential losses) by an entity with access to the world's best financial engineering and mathematical risk models: this makes UBS a prime exhibit for our argument that too much unthinking reliance has been placed in the precision of mechanical models leading to extraordinary losses when the models prove inadequate.

As in Sachsen bank, senior management has been changed in recent months. The timing in relation to the losses is not quite clear, however, the CEO resigned in July 2007, after the hedge fund was closed but several months before the really big losses were reported. Seven of the eleven members of the Executive Committee were appointed since September 2007. There is a new Chairman since the 2008 AGM, but only one other Director is new this year.

Case B: "Too opaque to survive in the market" Northern Rock

Northern Rock, a moderate sized mortgage bank based in the North of England and which saw exceptionally rapid growth in the past decade generated the most spectacular events of the early stages of the crisis when, on September 14, 2007, retail depositors flocked to queue at all of its branches to withdraw their funds. The runwas triggered when the announcement of a liquidity support package by the authorities failed to include any clear assurance to depositors that their money was safe.[9] At the time, the UK deposit insurance system fully guaranteed only the first £2000, plus 90 per cent of the next £33,000 of the depositor's funds – and there was no track record of prompt payment from the deposit fund.

Like Sachsen bank, NR's immediate difficulties arose from their inability to rollover short-term wholesale funding on which they relied very heavily as part of their overall lending-driven growth strategy. The growth had been vigorous: total assets under management grew from just over £20 billion at end-1999 to over £100 billion at end-2006. All but £11 billion of this growth was funded through wholesale resources: retail deposits equalled only 22 per cent of the total by end-2006. Indeed, so good was NR thought to be at this end of its business that it received the *International Financing Review*'s prestigious "Financial Institution Group Borrower of the Year" award for 2006. And we know that its internal risk-rating procedures were also highly considered by its regulator, the UK FSA, because earlier in 2007 it was granted the Basel 2 "waiver"

[9] The tripartite statement by the Bank of England, the Treasury and the Financial Services Authority (the regulator) could have been read as indicating that the liquidity support was conditional on Northern Rock having sufficient "appropriate" collateral, and that the FSA's opinion that Northern Rock was solvent was not shared by the other two authorities. The statement is at http://www.bankofengland.co.uk/publications/news/2007/090.htm

allowing it to lower its capital requirement by calculating it on the basis of internal ratings.

Although their operations did involve securitizations funded through special purpose vehicles, constructed for the purpose of generating and separately-financing highly-rated tranches of MBS, the underlying assets being financed were in the main originated by NR themselves (rather than being part of the US subprime market).[10] NR were popular with their borrowers and there has been little suggestion of the kinds of abuses involving pressure sales, fraudulent valuations and documentation and the like associated with the US sub-prime market. But with market sentiment moving against MBS and spreads rising, NR were particularly badly hit by funding difficulties. Even if they could rollover the funding at prevailing rates in the market, the higher spreads were on such volumes of business that the whole bank would become severely loss-making. Besides, the market was aware of NR's aggressive lending (which included lending combinations amounting to 125 per cent loan-to-value ratio) and inferred that NR's loan loss ratios would be above industry average as the market turned down.

The market's refusal to rollover the funds sent NR to the Bank of England. The latter was at first reluctant to provide accommodation because NR was unable to provide collateral to the Bank's normal standards. Eventually, after a conspicuous delay and public statements which accelerated NR's funding difficulties, the Bank acceded to the largest

[10] Note that the accounts of the Special Purpose Entities created to hold the securitized mortgages were consolidated line-by-line into NR's accounts, a practice that was not followed at Sachsen.

liquidity loan provided by any central bank in world history.[11] NR depositors' funds were unconditionally guaranteed by the UK Treasury (which also embarked on an overhaul of the deposit insurance scheme with the intention of increasing coverage).

Continued high funding costs, continued falls in house prices in the North of England and rising delinquencies made sourcing new equity for NR difficult. Eventually it was taken into "temporary" public ownership (shareholders are to be compensated on the basis of an independent valuation), and some £3 billion of the Bank of England's loan was converted into equity provided by the UK Treasury. Already the losses reported in the first half of 2008 amounted to £0.6 billion -- about two-fifths of end-2007 equity.

Underestimating the volatility in the cost and availability of wholesale funding was a serious error, which led NR to leave itself very exposed. Given its rollover needs, even the £5.9 billion it had in cash in early September, 2008 counted for little. It could be said that part of the NR's woes were attributable to the self-fulfilling fears of wholesale funders: by withholding their funding they made NR's business model unsustainable. But at a deeper level, the model itself was highly vulnerable, with no fall-back position. Even a small deterioration in its funding costs was always on the cards. Once again a mechanical model—this time of liquidity availability rather than market or credit risks—had been exploited beyond its range of reliability. Not only did the bank build a very large business on fragile funding, but the business it built embodied very evident credit

[11] By end-2007, NR's indebtedness to the Bank of England stood at £28.5 billion = US$ 56.9 billion (€ 38.6 billion).

risks (growth, loan-to-value) that inevitably fed-back on the margin of confidence of its wholesale funders.

NR's capital cushion was also low, and was being pared down as much as possible: indeed, the bank's 2006 Annual Report (published in March 2007) noted with satisfaction that the soon-to-be implemented regime of Basel 2 would allow NR to cut capital even further (a fact which should give pause to enthusiasts of Basel 2 and those who feel that small modifications to the Basel 2 capital adequacy mechanics are all that is needed).

It remains to be seen just how well NR's mortgage book performs through the coming years. Could the firm have survived if it had been able to secure funding on a continuing basis at average market rates? This is not yet clear.

Other banks also suffered runs:

- Bear Stearns was the biggest victim despite its huge pool of liquidity totalling US$ 18 billion just days before it ran out of cash (like other investment banks, its liabilities were very short-term in nature). Its creditors were wholesale institutions: when Bear Stearns had lost its credit[12] with them the whole structure imploded, as its franchise (in common with that of the other investment banks) was based on its credit and its teams of skilled wholesale financiers: the former

[12] Aa with the GSEs, there has been the suggestion that speculators, having taken a short position, spread rumours about insolvency of Bear Stearns with the intention of driving down the share price. However, restrictions subsequently imposed on short-selling of certain firms' shares have not resulted in outperfomance of those shares since (Brunnermeier, 2008).

was gone, the latter both mobile and ineffective without access to funds) (Burrough, 2008; Kelly, 2008). This failure prompted official intervention, not least because of Bear Stearns' central role as a market maker in the credit default swap market. Interestingly, Bear Stearns subsequently published a balance sheet as of February 29, 2008 – just over two weeks before it failed – showing shareholders equity at a satisfactory US$ 12 billion: on the face of it, Bear Stearns looks like a classic Bagehot-type case, unusual enough in the crises of recent years: a solvent bank that became illiquid because of loss of market confidence. It will be some time before we can be sure about this.

– Lehman Brothers and AIG insurance group are two other complex financial institutions which foundered because the market lost confidence in their solvency. Lehman's became unable to secure the continued wholesale financing on which its business model, like that of Bear Stearns, relied. Despite its size and the elaborate structure of customer links in its business, the Federal authorities decided it was neither too big nor too connected to preclude allowing failure and it filed for bankruptcy on September 15th, 2008, at the start of what was to become a week of exceptional market turbulence.[13,14] Later that week, the even larger insurance group AIG saw its credit ratings downgraded, triggering significant margin calls which gave rise to an immediate requirement for emergency access

[13] Several money market mutual funds held Lehman debt at the time of the bankruptcy. One of the largest, Reserve Primary saw its net asset value fall consequentially below par value – not a failure event per se, but quite exceptional for such funds. This led within days to the introduction by the authorities of an insurance facility for money market funds, as well as other measures to support the high quality asset-backed commercial paper market through direct official purchases and non-recourse lending to banks collateralized by by ABCP acquired effectively at cost from money market funds.

[14] The proposed purchase of Merrill Lynch by Bank of America, and of Britain's HBOS by Lloyd's Bank were the largest other institutional ownership restructurings announced that week. Emerging economies were not exempt from such pressures; for example, KIT Finance, a second tier intermediary in Russia, received an emergency injection of funds (less than US$ 1 billion) from State-controlled Gazprombank.

to liquidity. In this case bankruptcy was averted by the establishment of a special revolving loan facility of up to US$85 billion at the extraordinarily high interest rate of LIBOR plus 8.5 per cent. (The Fed was also to receive warrants for almost 80 per cent of AIG's equity). If fully drawn, this facility would exceed the previous record for an emergency loan by a central bank (currently held by Northern Rock). The interest premium will partly compensate the Fed for credit risk, and also provide a strong incentive for AIG to liquidate assets and downsize. In the market conditions of mid-September, it was impossible to say whether AIG or Lehmans were solvent in underlying asset value terms. Both proved to be too opaque to survive in the market. The decision to rescue one and not the other was likely based more on the relative disruptive consequences.

- Fortis, which was rescued by a government[15] injection of equity funds at end-September, 2008 was struggling to digest its purchase of parts of ABN-AMRO; the market lost confidence in its ability to come through the turbulent market conditions. Digestion problems with acquisitions also clouded the prospects of Wachovia bank, which received open-bank assistance in the form of guarantees on its asset portfolio from the FDIC to enable it to be taken over by Citi on Sep 29th, 2008. So this too was a too opaque-to-value case.
- Dexia and Hypo RE were wholesale concerns whose reliance on short-term funding became a fatal weakness as money markets seized up.

[15] In this case it was a coordinated intervention by the governments of Belgium (which was the home regulator), Netherland and Luxembourg. In the case of Dexia, rescued the following day, coordination of public sector stakeholders in France, Belgium and Luxembourg was required. Surprisingly, the fiscal coordination was effective, possibly because decisionmakers felt that the banks' equities were undervalued in then current market conditions and that they would therefore stand to make a profit on the intervention.

– California's IndyMac (which has been criticized for many loan origination abuses in the subprime market) also saw runs when an influential politician indicated (correctly) that its survival was in doubt. Once again the institution lasted only days. In this case, however, it was not a case of a self-fulfilling panic, the institution was already deeply insolvent when the run began. Interestingly, many of the customers who ran the bank – at evident personal inconvenience – were fully insured by the FDIC whose record in ensuring prompt access to insured funds of failed institutions is exemplary. It is not easy to explain this apparently irrational behaviour but it does reinforce the idea that limited deposit insurance is not a foolproof tool for avoiding runs, but instead serves at best to provide political acceptability for bank closures. Fundamentally, though, IndyMac's weakness was more conventional: poor – if not abusive – underwriting and increasing difficulties in onselling mortgages originated. As such, IndyMac arguably belongs more to the next category of failure, the "gambled and lost"

Case C: "Gambled and lost" -- Sachsen Bank

In each case there is a back story, an overall context which made the management error more likely; the impact of an external shock larger.

In the case of Leipzig-based Sachsen bank, reports speak of an underperforming bank (it was the smallest and newest of the German state banks, set up after German reunification in 1992), which had—thanks to EU legislation intended to level the international playing

field for banks within the Union—recently (July 2005) lost the significant competitive advantage of a state guarantee of deposits. Both the suggestion of less than stellar top management and boardroom skills combined with a desperate need for a new source of profits to allow the bank to survive as a profitable entry are features of this back story which help explain why large and growing profits from an offshore affiliate seem to have been uncritically welcomed by the bank's top decisionmakers.

In fact, what the affiliate (based in Dublin's[16] International Financial Services Centre) was doing was not all that different from what many other banks were doing; only its scale differed, relative to the scale of the sponsoring bank. It had established off-balance sheet "conduits" to hold mainly US mortgage-backed securities in a volume equivalent to about one-third of the parent bank's balance sheet. These highly-rated securities were financed by short-term borrowing in the market at rates very slightly finer than the securities were yielding.[17] The Dublin operation contributed 90 per cent of the Group's total profit in 2006. The catch, from Sachsen's point of view, was that the conduits had also been given in effect a back-up loan facility from the parent bank Sachsen itself. Failure to rollover its borrowings would lead to the conduit calling on Sachsen to provide the refinancing. The scale of the commitment was huge: the eventual rescue involved a liquidity injection approaching 25 per cent of the total balance sheet of the parent bank.

[16] As it happens, the name of the most problematic of Sachsen's SIVs, "Ormond Quay", is the name of the riverside street onto which the board room of the Central Bank and Financial Services Authority of Ireland looks out!

[17] As Brunnermeier (2008) notes, the use of structured financial products in the conduit business allowed Sachsen to continue to source AAA-rated funding (previously available to it thanks to the government guarantee, but which its balance sheet alone would not support).

A reading of Sachsen's 2007 Annual Report (p. 81) suggests that the risk management systems of the bank did not consider this as a credit or liquidity risk, but merely as an operational risk, on the argument that only some operational failure could lead to the loan facility being drawn down. As such, it was assigned a very low risk weight attracting little or no capital.

Press reports indicate that the German banking regulator BaFin was not altogether happy with the risks surrounding the activities of the Dublin affiliate of Sachsen. It commissioned a special on-site study by external consultants KPMG as far back as August 2004; who are reported to have made some very critical comments, but who may also have been unlucky in their sampling of the funds and conduits, so that they did not see the worst of the portfolio (Balzli et al. 2008).

Of course, with repeated downgrades of mortgage-backed securities and the seizing-up of European money markets in the late Summer of 2007, the scale and costs of this commitment became evident to all. Conduits could not be refinanced and Sachsen could not itself borrow enough in the market to meet its lending commitments to the conduits.

With the prospect of Sachsen failing and official fears that this would result in a systemically damaging market reassessment of the credit risk of German financial institutions, a pool of public sector banks stepped-in (August 17, 2007) with a temporary credit line for the conduits, at a penalty rate.[18]

[18] At least 50 basis points of penalty (European Commission 2008a); note that this penalty was equivalent to 5 percent per annum on the end-2006 capital of the bank.

After several months of negotiation, Sachsen was sold to another German state bank, the much larger Stuttgart-based LBBW, which will continue Sachsen's regional SME and other business under its old name in its existing regional market, which complements that of the purchaser.

Costs and losses: The transactions surrounding the sale of Sachsen and write-downs and losses over the past year are quite complex but in broad terms it appears that the owners have lost about €1.5 billion from Sachsen's MBS adventure; a rather small sum, compared with some of the other banks (and compared with the scale of the liquidity bail-out) but enough to wipe-out the end-2006 book value of Sachsen's capital. There is still a contingent liability from a new "super-SIV" structure created to hold some of the worst-performing parts of mortgage-backed portfolio, totalling €17.3 billion. This structure benefits from a first-loss guarantee of €2.75 billion from the State Government of Saxony (which was in effect the controlling owner of Sachsen Bank before the sale).[19] That guarantee is 2½ times LBBW's worst case stress-test estimate of the negative value of the super-SIV.[20]

The crucial error at the heart of Sachsen's business model was not so much its reliance on an underpriced guarantee from parent to off-balance sheet vehicles, but the scale on

[19] It held 27 per cent of the equity directly and a further 14 per cent through its share of a consortium.
[20] LBBW and the vendors agreed that the expected loss on the super-SIVwas less than €0.5 billion (though this figure is in turn less – maybe much less – than the mark-to-market value of the SIV's assets at the time of the final negotiations) (European Commission 2008a). In addition, €0.5 billion of other write-downs were taken on Sachsen's books before the sale (European Commission, 2008a).

which these guarantees were made in relation to capital and balance sheet scale. They "bet the bank" on the validity of the ratings and lost.[21]

Not only did senior management and the shareholders lose out in the Sachsen bank case but, this being a public sector bank, there were political repercussions and the Prime Minister and Minister of Finance of the Saxony Regional Government resigned within the year.

Case D: "Overleveraged mortgage lender"-- The GSEs

I will not provide much background on the two largest US GSEs, FNMA and FHLMC. Because of their curious hybrid character, seemingly in the private sector, but established under special statute, separately regulated from the rest of the banking system, and with their debt benefiting from various regulatory privileges, the systemic risks potentially presented by these entities had already been extensively discussed in the literature before the crisis broke (cf. Jaffee, 2003; Eisenbeis, Frame and Wall, 2007, Poole, 2007) In fact, by mid-2008, the focus on these two entities had shifted to the scale and nature of the likely US government bailout of creditors, and in particular what the prospects were for the private shareholders.

[21] From this point of view the case of the other small German bank IKB is somewhat contrasting. They also acquired MBS both on and off-balance sheet and their crisis was also triggered by a failure (at end-July 2007) to rollover short-term financing for an off-balance sheet vehicle to which they had guaranteed a line of credit which they were unable to deliver. But IKB had taken much lower-rated tranches: for example only 73 per cent of their sizable on-balance sheet MBS were rated AAA or AA. A rescue led by the large development bank KfW (owned by the German Federal government) was organized. Eventually the sale of IKB to a venture capital fund was announced in August 2008; KfW stated that its losses from the IKB rescue would be about €8 billion.

In terms of the total value of mortgage-related securities owned or guaranteed, Fannie and Freddie are at the other end of the scale from Sachsen, with about US$ 5 trillion, an amount equivalent to over one-third of US GDP in 2007. More than two thirds of this relates to guarantees mainly on securitized mortgages packaged by the GSEs out of "conforming" (moderately-sized and *not* sub-prime) mortgages offered to it by other market participants; the remainder relates to an on-balance sheet portfolio of mortgage-backed assets which can and does include nonconforming loans.[22]

The on-balance sheet MBS are subject to the risk that the underlying fixed rate mortgages will be prepaid, whether because interest rates have fallen or for other reasons. This risk is hedged by the GSEs' treasury function through the funding instruments and derivatives, but perfect hedging is not practicable leaving the agencies with appreciable non-credit risk as well as the credit risk of the underlying mortgages. Indeed, the non-credit risk has long been thought the dominant one (Jaffee, 2003; Eisenbeis et al., 2007), hence the regulatory capital requirement (leverage)[23] for the on-balance sheet risks was set much higher (2.5%) than that on the guarantees (0.45%). Still, the result is that the GSEs reported stockholder's equity totalling only US$ 68

[22] About 15 per cent of the agencies' total mortgage book of business relates to sub-prime or Alt-A mortgages (CBO, 2008).

[23] The GSEs are subject both to the higher of the leverage requirements as specified in the text and a risk-based capital which is based on a stress-test and in practice has been lower. (Following accounting irregularities uncovered in 2003-4, the GSE regulator OFHEO imposed a temporary surcharge onto these requirements; the surcharge was lowered in February 2008). However, independent modelling by Posner and Brown (2005) of Morgan Stanley generated much higher *economic* capital requirements (of between 4.5 and 7 per cent) to meet a stand-alone AA rating. They took account of such modelling uncertainties as the likelihood of prepayment depending on turnover in the housing market as well as the costs of hedging prepayment risk (convexity). The gap between the regulatory and economic capital measures understates the subsidy value of the implicit government guarantee in that the agencies funding costs have been much lower than that applying to AA firms. Thus at August 2008 Standard and Poors gave Fannie Mae a "Risk to the Government" rating of just A+, while it was still rating the agency's long-term debt at AAA.

billion at end-2006 supporting that US$ 5 trillion. By mid-2008 the total reported equity had fallen to US$ 54 billion – supporting an even higher total mortgage book.[24]

Sure enough, with the recent turbulence—including volatility and unexpected cross-instrument correlation patterns—in short-term money markets, there was the potential for surprises and losses in the hedging function.[25] But that does not in practice seem to have been the main problem causing the deteriorating financial position of the GSEs in 2007-8. Of course, while there is no evidence yet that the complex non-credit risks will generate losses in excess of the capital allowed for them, it is too early to say that this will remain true. However, according to the accounts up to the first half-year of 2008, it seems that credit-related losses both realized and unrealized, were by far the most damaging. Between them, the agencies acknowledge credit-related losses of US$ 16.3 billion in the 18 months to mid-2008. So it seems that plain vanilla credit losses on a portfolio of largely conforming or prime mortgages have been sufficient to wipe out almost all of the capital assigned to credit risk, if we assume that the figure of 0.45 per cent applied across the board.

But they also note additional net mark-to-market losses on their mortgage book totalling US$ 35.2 billion which they have not realized in their income account (because they believe these reflect liquidity conditions which are temporary and do not imply a

[24] And that is according to the GAAP conventions. At fair value, FRE's liabilities actually exceeded its assets by early 2008, and at fair value the two agencies' aggregate assets exceeded liabilities by only US$ 7 billion (CBO, 2008). The agencies also placed considerable value on deferred tax write-offs to which they were entitled, but whose realization would require them to make sizable profits. Their valuation procedures for delinquent loans were also relaxed in 2007-8 again flattering their accounts.

[25] The agencies' accounts make no attempt to estimate the net effect. FNMA lost over $4 billion on its derivatives portfolio in 2007 but it is not stated how much of this merely offset interest rate-related gains in the fair value of the remainder of its portfolio.

probability of default). Since the reporting date of end-July, the agencies acknowledge a further worsening in the risk of credit losses. Adding the realized and unrealized losses we get a total in excess of US$ 50 billion lost in 18 months – only 1 per cent of the mortgage book, but well over ¾ of the shareholders' funds at end-2006!

This was not apparently the result of unknowingly acquiring a more toxic part of a structure than expected. The models employed seem to have simply understated the plausible range of loan loss rates on a portfolio of mortgages. All of the elaborate models constructed to hedge the prepayment and other structure-related risks have proved an irrelevancy relative to the simple move of mortgage defaults outside the historic range. It is not clear how a mechanical model could have improved over a historically-informed sense of the potential for risks to arise in unexpected places.

The overall range of plausible losses that will ultimately be borne by the two GSEs remains wide. On July 22, 2008 the US Congressional Budget Office (2008) released its calculations of the possible draws that might be made on US Government funds to insulate creditors of the GSEs from loss and thereby ensure systemic financial stability. Their estimate was in a range from zero to US$ 100 billion, with an expected value of US$ 25 billion.

Legislation to enable the US Treasury to commit such funds was enacted at that time, and on September 7, 2008 action was initiated to inject funds. On that day the two firms were taken into the Conservatorship of their new regulator the Federal Housing Finance

Agency (FHFA); dividend payments were suspended and the CEOs replaced. At the same time the Treasury (i) injected US$1 billion and received senior preferred shares carrying a 10 per cent coupon and warrants for 80 per cent of the two firms' common stock with a nominal exercise price; (ii) undertook to make good any future capital shortfall as determined by FHFA in accordance with US GAAP (i.e. ensuring compliance with a zero capital adequacy requirement); (iii) started a program of acquiring agency-backed MBS in the market. In addition, the two firms were given access to a new liquidity facility at the Fed.

Given the drastic perceived consequences by a wide range of authoritative commentators[26] of a default on agency paper, in terms of market turbulence, political fallout (given the large foreign official holdings of GSEs), and the functioning of the mortgage market,[27] the US Government's action to step in was all but inevitable. The technique used minimized formal disruptions: thus the Government did not formally take over all of the firms' debt, nor were the firms closed and liquidated. Shareholders were diluted by 80 per cent and dividends frozen; although their share prices had already fallen more than 90 per cent from their peak, they suffered a further sharp fall immediately after the announcement to about 1 per cent of their peak value. The inevitability of the intervention and the open-ended nature of the government's liability in this condition confirms that the regulatory model used allowed these firms to operate on far too thin a

[26] Recent speeches and op-ed pieces by Summers, Greenspan, Krugman and the Chinese central banker Yu Yongding may be mentioned in support of this claim,

[27] Whether the US mortgage market really needed the agencies has long been debated. Estimates in the literature suggest it has probably helped lower the cost of conforming mortgages by up to 25 basis points (Eisenbeis et al., 2007). But there is little evidence that increases in their purchases of non-conforming assets affect mortgage rates or spreads (Lehnert et al., 2005). Other industrial countries rely on other forms of subsidy to support home ownership and none has closely imitated the US model .

cushion of capital. It remained unclear why tighter regulation had not been imposed earlier: close supervision of the agencies' complex activities and limitations on their assumption of additional risk would be the conventional regulatory guidance for such entities. But because of their perceived role in sustaining mortgage availability, the GSEs actually saw a relaxation in capital adequacy requirements and risk-taking in early 2008, and they had responded by increasing their portfolio of mortgage-backed securities since this relaxation.

If the GSEs had a rationale in the new century, it was that mortgage banking remained fragmented and the main participants did not have the scale or geographical range to diversify credit risks and to lay-off pre-payment and other risks. These risks could be laid-off using financial engineering, but a large share of this engineering was captured by just two intermediaries thanks to the implicit government guarantee which they enjoyed. Inadequate risk modelling allowed regulators to tolerate capital levels so low that they have now triggered what is likely to become a sizable call on that implicit guarantee.[28]

3. Naïve belief in the perfection of models and markets – different dimensions

Exaggerated belief in the precision of mechanical risk models induced the world's top financial institutions to bypass common-sense precautions. How else could they have ignored the evident conflicts of interest involved in originate-to-sell or assumed the enormous credit exposure they took to an entirely new line of business, the sub-prime

[28] The blanket government guarantee of the liabilities all six main Irish-owned banks on September 30, 2008 was triggered by market concern over the property-related portfolio of these institutions, given falling property prices in Ireland and the UK.

mortgage and its close relatives. Exaggerated extrapolation of improved financial market efficiency into a naïve belief (also perhaps based on a supposed perfectibility of institutional risk-management) of ultra-liquidity induced others to act as if perfect liquidity was indefinitely assured.

Modelling of many different types of process crucial to assessing risk have proved defective.

Most fundamentally, models of house-price movements and of the relation between negative loan-to-value ratios and borrower default. As house prices continue to fall, the degree to which intermediary and rating agency assumptions on key parameters here were inadequate is becoming increasingly important as the explanation for the scale of overall losses. Demyanyk and Van Hemert (2008) present regression analysis showing that – after adjusting for observable loan and borrower characteristics, a trend rise in delinquency rates should by 2005 have clearly pointed to a broad deterioration of underwriting quality that ought to have been factored-in to ratings. Calomiris (2008) suggests that extrapolation of previous default experience should have made it clear to specialists that the assumptions built into MBS ratings were based assumptions that (even ignoring the dramatic expansion of subprime lending in 2005-6) were overoptimistic, but that they continued to use them because of distorted agency incentives.

Models of tranche risk in securitizations are also a complex area which has been usually left to the ratings agencies. Mason and Rosner (2007) provide a good account of some of the complexities here and in particular how they interact with rating agency incentives. We have already alluded to the contrasting impact of unexpectedly high correlation of underlying mortgage values: the potentially dramatic increase in default risk on senior tranches (and reduction on junior tranches) undermine pricing and create considerable risk for entities that have opted for high volume–low spread business model using the senior tranches.

Models of short-term interest rate spreads underestimated the degree to which the marginal cost of wholesale funds to intermediaries could deviate from risk-free rates. Firms such as NR and Sachsen had business models which required more stable spreads; the higher market-wide spreads that emerged and persisted made these business models loss-making to an extent sufficient to wipe-out capital. (Recognizing this, the market ran from, or refused to refinance, those and some other intermediaries, accelerating their failure; but they were doomed by the wider spread). More complex reliance on models of interest rate spreads caused problems elsewhere, as in the hedge fund Carlyle Capital discussed below.

More acutely, most models in use have not embodied the possibility of money markets simply not clearing. (The experience of the Auction-traded securities market in the US in February 2008 makes it clear that this can happen even when credit risk is not an issue).

Prepayment risk has always been recognized as important in the financing of fixed rate mortgages and hard-to-model, given that it depends on such factors as housing market turnover and the ease with which borrowers can secure refinancing. Despite the huge efforts that have gone into modelling static and dynamic hedging strategies (using derivatives) that transactions cost with the reduction of exposure to prepayment risk, this does not seem to have been the dominant factor in causing losses this time around.

Some firms have failed because derivatives strategies misfired. A high-profile case is the hedge fund Carlyle Capital Corporation, which defaulted on the bulk of its US$20 billion debt on March 12, 2008, just a couple of days before Bear Stearns (which was one of its creditors). It has sometimes been suggested in market commentary that Carlyle CC was the victim of widening spreads on GSE obligations as if it was a victim of weakening market confidence in agency debt. However, the story (as described in the firm's Annual Report published less than a month before it failed) is quite different. In fact, by early 2008, Carlyle CC's assets were almost entirely in AAA-rated GSE bonds issued as part of the GSE's management of interest rate risk at floating rates, but with an interest rate cap. This cap generated a higher running yield on the bonds (because the cap was never reached), but the cost of the embedded option implicit in the cap increased sharply with the increase in both the level and volatility of money market rates from August 2007 on. Because of its high leverage and concentrated holdings of these bonds with an average maturity of 4-5 years, the capital loss thus imposed on Carlyle CC was sufficient to drive it into insolvency. As Carlyle CC was a hedge fund and not a bank, it would be wrong to

say that their model was flawed – just highly risky and likely more so than they realized based on their modelling. Here the major losers were hedge fund equity investors: large creditors were substantially insulated by holding the collateral.

Contract risk, such as arises in Credit Default Swaps is another area in which model error from oversimplification is often seen. Two excellent examples are provided by Morgenson (2008a and b). Her first example shows how the informality of undocumented understandings can dramatically alter the payout of these complex instruments; the second, shows how sellers of protection against GSE default might suffer from a bailout: if dividend payments to preferred shareholders are suspended in a bailout of fixed interest creditors, then this credit event would likely trigger payment of credit default protection.

(Lack of transparency adds to modelling difficulties, though as discussed by Allen and Gale, 2007; and Adrian and Shin, 2007, under some circumstances too much transparency can amplify cascade effects on confidence accelerating systemic collapse.)

4. Containment and resolution

A large literature has grown up on containment and resolution policies in banking crises, drawing not only on historic experience of advanced economies but also from the numerous and costly events experienced over the past three decades in developing countries (cf. Honohan and Laeven, 2005). The IMF and the World Bank established a financial sector assessment program in which most of the IFI membership (though not

yet the US) has already participated and which focuses on evaluating and advising on financial stability policies including crisis management policies.[29] So how has actual practice in this crisis with regard to failing banks matched-up to the "best practice" emerging from this large effort? I am going to abstract entirely once again from systemwide issues of policy on policy interest rates and on terms and conditions for access to refinancing facilities, confining myself to a brief discussion of failure cases.

I will comment on whether action was speedy or whether there was forbearance, on moral hazard aspects of intervention affecting equity and management and finally look at the fiscal costs as they are emerging.

Speed of action or forbearance?

The importance of speedy action in containment is stressed by many. Dramatic weekend and even mid-week action has characterized several of the official interventions in this crisis, including those at Sachsen, Northern Rock, IKB, Bear Stearns. Indymac and Roskilde. With the exception of the last-named, however, these were all collapses driven by illiquidity which needed some immediate response.[30]

At another level, though, it could be argued that intervention was too slow even in some of these cases. Sachsen Bank's Dublin operations were causing anxiety to the regulator

[29] As well as on financial development issues in the case of developing countries.

[30] There has been a debate over whether a more speedy and comprehensive official response to the retail depositor run on Northern Rock would have been helpful (House of Commons, 2008). Only a few days are at issue here, though, and there is little indication that the end-result for the institution or for the system as a whole would have been much different one way or another if the action eventually taken had been brought forward by a few days.

of its German parent as far ago as August 2004. Roskilde Bank, intervened in August 2008, has also been under a cloud for some time. And of course issues surrounding Freddie and Fannie have been discussed for years.

An interesting feature of the crisis has been the irrelevance or ineffectiveness of deposit insurance schemes; either they have not covered the institutions or depositors concerned, and do not seem to have precluded even insured depositor withdrawals.

Equity shareholders

By and large, equity shareholders were hit quite hard in these failures, until the last few days in September. Indymac and WaMu shareholders will probably get nothing (with heavy losses also for subordinated debt holders), and the same is true for Roskilde Bank. We don't know how much the Northern Rock shareholders will get, but since the independent valuation is intended to price the shares on the basis that no liquidity support from the Bank of England would have been available, the price is likely to be very low. Bear Stearns shareholders certainly looked as if they might even have a below-fair-value payoff imposed on them at first, and the price finally agreed was not high. GSE share prices have lost 98-99 per cent of their value of a year or so before the intervention. About 90 per cent of this had happened before intervention, at which stage the share value was supported mainly by the prospect that the inevitable intervention would not involve equity dilution.

It might be thought that this aspect didn't matter for the two German banks since they were public sector entities, but allocation of resources between different agencies within the public sector is not without real consequences. Thus, for example, we note that the Danish National Bank is seeking indemnification from the Danish Government for any losses arising out of its equity investment in Roskilde Bank.

Shareholders can resist low offers and that is one of the main reasons why legislation providing for special insolvency arrangements is especially helpful for effective intervention and resolution. The lack of a special resolution regime for UK banks hampered the speed of intervention there and is somewhat surprising given the emphasis on the necessary power of supervisors in closing and unhealthy bank set out in Basel Core Principle 22 adopted (especially for the guidance of developing country policymakers) as long ago as 1997. This is now being corrected.

Despite shareholder losses, banks with a continuing franchise have succeeded in securing new equity investment. Sachsen and IKB have been sold by the initial rescuing agency and the bulk of their client base and product lines will continue. UBS, like other major banks, has been able to tap new or traditional sources of equity. Not all failing entities are in this happy position: Northern Rock's lack of deposit resources and its heavy reliance on the contestable and currently depressed residential mortgage market made it unattractive for buyers and it is being severely downscaled in government ownership.

Management

Here the story is somewhat more mixed and will in time deserve a fuller treatment. Many senior managers and directors of failing banks were removed. But one would have to go well beyond a simple count to assess whether a good balance was struck between (on the one hand) retaining experienced people and (on the other) disciplining underperformance and breaking dysfunctional customer links. Top management of the two German banks was changed quickly and compensation was negligible. Northern Rock's CEO's pension and compensation (one year's base pay) gave rise to some criticism, but appear to have been set in his contract of employment. Compensation for the departing CEOs of Freddie and Fannie are understood to be considerably more lavish.

Of course, this does not speak to the question of incentives more widely, including for banks that didn't fail. The unsatisfactory situation here, with boards struggling to balance the need to incentivise key staff with packages that offer security as well as gain, with the need to protect the institution against reckless or careless behaviour, is widely discussed.

Taxpayer costs

Table 2 presents a structure within which estimates of the fiscal cost of the crisis can be structured. So far, the figures for banks that have actually had concrete government assistance – tentative as they are – seem surprisingly low for a crisis that has been described as the worst since the Second World War. My latest estimates (Honohan, 2008) of median fiscal cost of 78 systemic crises 1970-2006 was 15.5 per cent of national GDP. Expressing the US$126 billion figure as a percentage of US plus European

Economic Area GDP on the grounds that the losses have been spread across at least the banking systems of at least all of these regions produces a figure of less than ½ per cent of GDP.

The categories are more defensible than the exact numbers in the table. Only a few cases can be said to have crystallized: limited uncertainty remains with regard to the US$15 bn allowed for IKB and Sachsen bank, given their sale back to strong banks with defined guarantees. The FDIC cost (we take it as a public cost even though FDIC's fund is generated from insurance premia) amounts to $10 billion, of which $9 billion relates to Indymac. Interestingly, there was no FDIC cost to the closure in September 2008 of the much larger WaMu (Washington Mutual); it was insolvent when intervened, but the insured deposits were transferred to JP Morgan Chase, and the franchise value of the branches and assets generated enough cash in the resolution to pay off the uninsured depositors (though not all creditors).

For the nationalized Northern Rock we have entered HM Treasury's injection of £3.4 billion in equity; for Bradford and Bingley are included the deposit insurance payout of £14 billion and the UK Treasury's cash outlay of £4 billion. In principle, some of this could be recovered if loan recoveries are high. For Fortis we included all of the September equity injections. The figure for the NY Fed's non-recourse financing of the Bear Stearn's transaction is pure conjecture: the Fed might even profit from this deal in the end even if the mid-March valuations of the collateral prove reasonable. The AIG loan could easily add US$ 15 billion in losses to the Fed. The amount of losses that

might arise from collateralized lending already made by Central Banks can be gauged by reference to the figures which are high: around €450 billion by the ECB and over US$400 billion by the Fed system one way or another. These are overcollateralized loans, though the quality of the collateral being presented has likely deteriorated (cf. Buiter, 2008). On the other hand this lending is mainly with recourse: losses will only arise in respect of borrowers that fail.

One reason why the figures in the table are so (relatively) low is that the losses from subprime were very broadly spread across many of the World's largest banks as well as other financial institutions and funds. The aggregate capitalization of these institutions was big enough to absorb hundreds of billions of losses, and their diversified businesses and franchise value remained intact, allowing most of these institutions to recapitalize at least partially, tapping funds that had not been hit.

The second reason is that some of the fiscal losses had not yet been identified as of Septemnber 2008. If US and other housing prices were not to fall any further, it might be plausible to suppose that much of the losses embedded in mortgage-backed securities have already been recognized. But house prices in the US and several other economies show little sign of stabilizing, giving cause for concern that a second wave of losses, extending to prime mortgages could be in the offing. Such losses would likely be concentrated in mortgage lenders. Furthermore, a broad and protracted economic downturn, to which the credit crunch could be contributing, will itself exacerbate losses

in other segments. If so, the authorities may suffer extensive further costs of intervening other banks.

Practitioner experience with systemic crises around the world suggests that early estimates of loss in a systemic crisis underestimate the total, but that they subsequently overshoot. It is not clear where we are in this cycle. However, the shift at end-September, 2008 to open-bank rescue schemes of one sort or another promise to increase the government's share of the total loss burden. For example, the US Government's US$ 700 billion mortgage-related asset purchase scheme (proposed on September 19th , 2008, but rejected by Congress) provided few safeguards against the likelihood that government would absorb a higher-than-necessary share of the costs. The difficulty of limiting the fiscal costs of adverse selection in such a scheme (buying bad assets from going concern banks), suggest that net costs could be high, as they have been in other countries (70-80 per cent of the gross outlays for similar schemes in China – admittedly a special case).

Given this shift to open-bank assistance, it would not now be a surprise if total fiscal costs ended up as high as $400 billion – still only a little over 1 per cent of the GDP of the US plus EEA.

5. Conclusion

15 years ago, Robert Merton (1994) cautioned; "The mathematics of [hedging] models are precise, but the models are not, being only approximations to the complex, real world. Their accuracy as a useful approximation to that world varies considerably across time and place. The practitioner should therefore apply the models only tentatively, assessing their limitations carefully in each application." As Merton (1995) also points out whereas equity capital is a wonderful all-purpose risk absorber it is costly; on the other hand, hedging (for example through the use of derivatives) is targeted and relatively inexpensive.[31]

If we know where our risks are coming from we can, nowadays, find a market in which those risks may be hedged, thereby releasing capital that would otherwise have been required. But if we overestimate our ability to foresee the precise nature and scale of the risks which we face, and as a result overestimate the extent to which our hedges reduce the need for general purpose capital, then we may be in trouble. Our hedge fails and we may have made no back-up provision—after all, saving on capital was the point of the hedge.

[31] "The management of risk has traditionally focussed on capital. Equity capital is the 'cushion' for absorbing risks of the institution. It is a wonderful, all-purpose cushion. Why? Because management need not know what the source of the unanticipated loss is. They do not have to predict the source of loss, because equity protects the firm against all forms of risk; it is in that sense an all-purpose cushion and thus it is very attractive for managing risk. As we all know, equity capital also can be quite expensive for exactly that reason…The other fundamental means for controlling risk is through hedging. In contrast to equity capital which is all purpose, hedging is a form of risk control that is very targeted... To hedge, the firm must not only specify what kind of risk it is hedging but also the exact quantity of that risk. Hedging is a form of risk control that can be very efficient as a substitute for equity capital but it carries with it the requirement that its users have a deep quantitative understanding of their business. They must understand much more about their structures than in the case of all-purpose equity capital." Merton (1995)

Each of the banks studied failed – or at least got a bad fright – because their models of the risks to which they were subject proved to be too sanguine. The banks with the biggest reported losses did not fail because their businesses was diversified and included profit streams and capital reserves from other lines that were not affected by the mortgage-related problems.

Risk management textbooks are replete with advice on the need for holistic assessments avoiding silos and involving a fundamental look-through approach.[32] But it is clear from the pattern revealed by these failures that the implications for discretion as opposed to rules, for overall judgment as an override on mechanical models, has not been fully taken on board whether by intermediary managements or by prudential regulators.

[32] Recent reports by IIF (2008) and BIS (2008) reiterate these familiar but widely ignored counsels.

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Table 1: *Some Key Financials for the Four Cases*

US$ billion	Sachsen Bank	Northern Rock	UBS	GSEs
End-2006 Total assets including relevant off-balance	109.6	198.0	1924.0	4352.9
End-2006 Total assets on balance sheet	82.2	198.0	1924.0	1648.8
End-2006 Shareholders' equity	1.9	3.3	40.8	70.9
Leverage	*58*	*59*	*47*	*61*
Reported credit-related losses 2007 and 2008H1	2.3	1.7	44.0	16.3
Additional likely losses	1.3	2.5	0.0	35.2
Maximum official credit line reached	22.6	55.9	0.0	0.0
Government solvency support	3.6	6.7	0.0	25.0

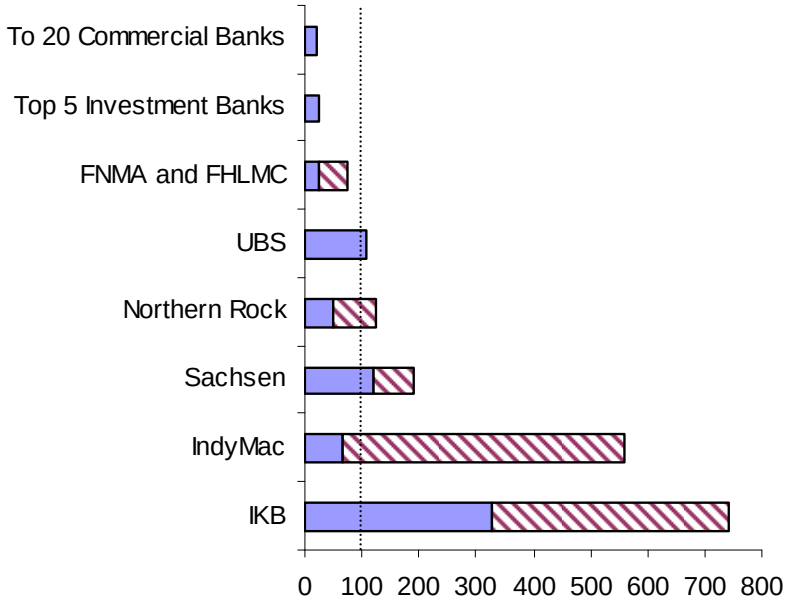
Exchange rate conversion for all figures is at end-2006 exchange rates.
GSEs refers to FNMA and FHLMC only.
"Additional likely losses" refers to relevant figures reported by the institutions or their owners, but not yet recognized in accounts – ultimate losses can be expected to differ; perhaps by a large amount.
Government solvency support: for Sachsen this is the first loss guarantee provided by the State of Saxony in respect of the Super-SIV; for Northern Rock it is the additional £3.4 billion in equity to be injected as announced in August 2008; for the GSEs it is the CBOs expected cost estimate for future support.

Table 2: *Acknowledged Fiscal Costs of Identified Bank Failures Jan 2007 to Sep 2008*

		US$ bn		Basis
(a) Identified institutions				
Equity injections	Fortis	16	↓	NLD/BEL/LUX Government equity
	IKB	11		KfW Statement
	Dexia	9	↓	FRA/BEL/LUX Public sector equity
	Bradford & Bingley	7		Dep Prot. pay to Abbey/Santander
	Northern Rock	7	↓	Government equity
	Sachsen	4	↓	Total Government shield
	Glitnir	1	↓	ISL Govt equity
	Roskilde	1	↓	Danish National Bank equity
Dep Insur payouts	Bradford & Bingley	26	↓	Government pay to Abbey/Santander
	IndyMac	9		FDIC
	15 other FDIC	1	↑	FDIC + Wachovia assets exposure
Intended fiscal support	FNM & FRE	25	↑	Congressional Budget Office
	Hypo RE	??	↑	DEU Govt liquidity guar up to $63 bn
	Ireland 6 banks	??	↑	Blanket guarantee of liabilities
Central bank collateral	Bear Stearns	4	↑	? Loss on NY Fed $29 bn facility
	AIG	15	↑	Scale indicated by interest premium
	Others	??	↑	Relaxation of collateral standards
(b) Future failing institutions			↑	
(c) Asset purchases from going concerns			↑	US scheme proposed Sep 19, 2008
(d) Distressed borrower assistance			↑	
Overall total		135++		

Note: Only covers assistance announced or provided by September 30, 2008. ↑ indicates direction of likely revision in this number. More on the basis of the figures: Fortis, Dexia, NR, Roskilde and Glitnir the full equity injection is used without subtracting the pre-injection share price. B&B total government outlay to Abbey/Santander not accounting for any net recovery on the rump.

Figure 1: *Reported and Plausible Total Losses as % of Initial Shareholder Equity*
Selected Institutions, 2007-8.



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